CMB imprints of a pre-inflationary climbing scalar

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Based on work w/ E. Dudas, N. Kitazawa, A. Sagnotti; 1202.6630, to appear in JCAP

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- What are the consequences of 'short' inflation? Ramirez, Schwarz '11

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- For a large class of models, the would be inflaton is forced to emerge from the big bang initially climbing up its potential.
- Subsequently, inflation effectively begins with the inflaton well off its attractor.

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- that provides the very impetus for inflation to begin (how did it get up the potential in the first place?)
- that motivates a novel phenomenon– starting inflation off the attractor.

Climbing scalars

We begin with the Einstein frame action

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- Consider the class of potentials $V \;=\; \frac{M^2}{2}\; e^{\,2\,\gamma\,\varphi}$, γ a model dependent exponent.

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- Where did the other branch go?
- c.f. $m\ddot{y} + b\dot{y} = g$. Limiting speed $v_l = g/b$.
  $\dot{y} = v_l + (v_0 - v_l)e^{-\frac{bt}{m}}$. As $b \to 0$, one branch is lost.

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- On general grounds, expect superposed oscillations.
- Can consider the presence of initial particles– which have the usual effect, but it is not natural to do so.

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Very typically, $\gamma \geq 1$, c.f. KKLT. So we consider the following potential (canonically normalized)

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Pre-Inflationary dynamics
Conclusions

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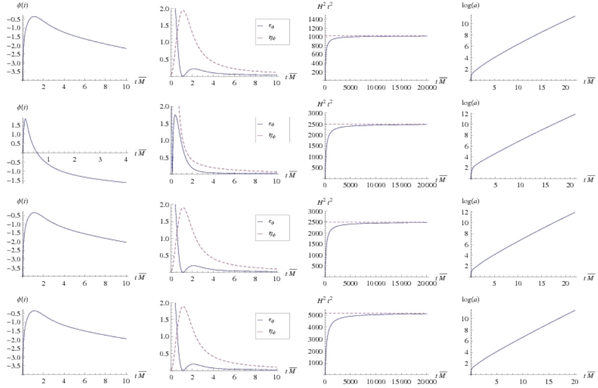
- 

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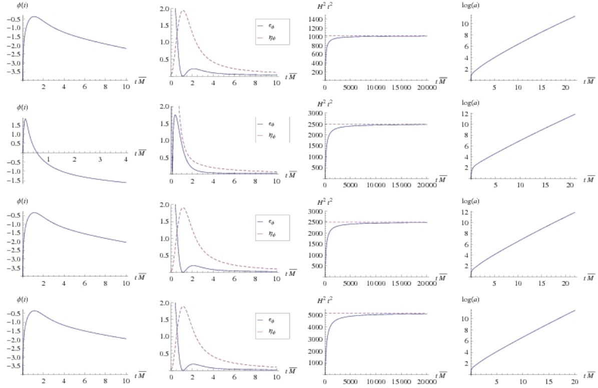
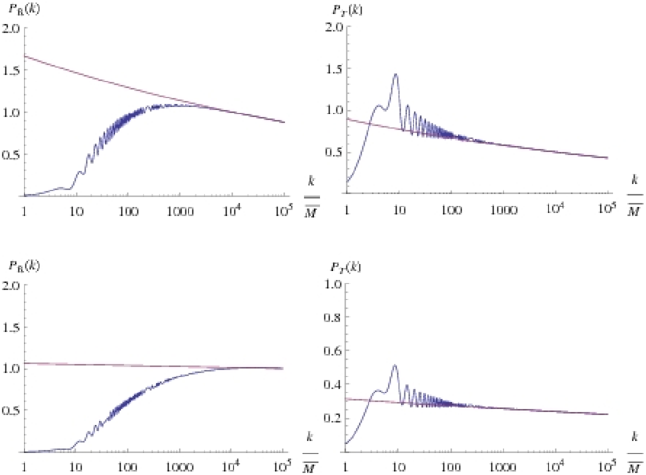
- 

- Background solutions for $\nu = \frac{1}{4\sqrt{6}}$ and $\phi_0 = -4$ (top), $\nu = \frac{1}{5\sqrt{6}}$ (middle two, with $\phi_0 = 0, -4$ respectively) and $\nu = \frac{1}{6\sqrt{6}}$, $\phi_0 = -4$ (bottom). Dashed line in third column indicates the LM attractor for $V = \frac{M^2}{2} e^{\sqrt{6}\nu\phi}$.

Climbing scalars



Scalar (left) and tensor (right) spectra for $\nu = \frac{1}{4\sqrt{6}}$, $\phi_0 = -4$ (top), and $\nu = \frac{1}{6\sqrt{6}}$, $\phi_0 = -4$ (bottom)– best fit with attractor spectra for $n_S = 0.944$, $n_T = 0.9375$ and $n_S = 0.995$, $n_T = 0.97$, respectively. LM attractor $n_S = n_T = 0.9375$ for $\nu = \frac{1}{4\sqrt{6}}$ and $n_S = n_T = 0.972$ for $\nu = \frac{1}{6\sqrt{6}}$.

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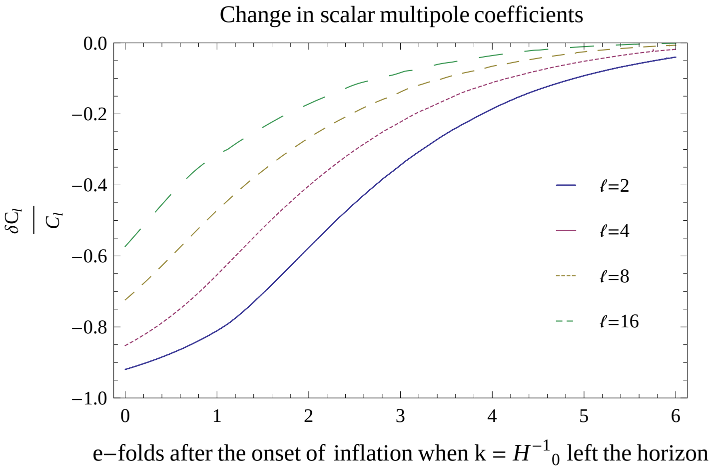

c.f. $\left|\frac{\Delta C_\ell}{C_\ell}\right| = \sqrt{\frac{2}{2\ell+1}}$

Climbing scalars

This long wavelength modification of power can readily be understood by considering

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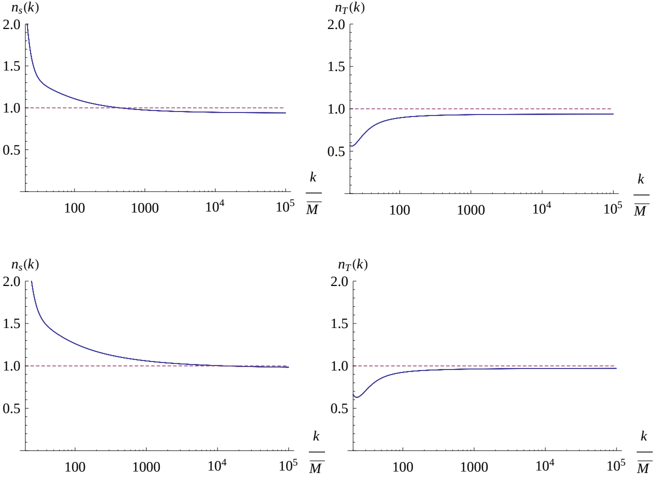
- Can understand modifications to long wavelength power in terms of spectral running.

Climbing scalars



- Running spectral indices for $\nu = \frac{1}{4\sqrt{6}}$ (top) and $\nu = \frac{1}{6\sqrt{6}}$ (bottom)

Concluding remarks

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